

Observations on the Nidamental Glands of *Hydrolagus collei*, *Raja rhina* and *Platyrrhinoidis triseriatus*¹

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A STUDY of the reproductive system and the nature of the reproduction of the elasmobranchs was started by me in 1940, with the idea of finding out whether or not there is any correlation between the phylogeny and the reproductive structures and habits. Emphasis was laid on such factors as oviparity, ovoviviparity and viviparity and the consequent structural modifications in the nidamental glands; but, owing to many reasons, it was not possible to gather enough data to draw any definite final conclusions. It was, therefore, thought that observations made whenever material was available could be published intermittently and final conclusions drawn at a later time.

My previous investigations were exclusively on Indian species. Having now had an opportunity to examine some of the Pacific species, it seems advisable to report on these forms. This work is a continuation of my papers on "The structure, phylogenetic significance, and function of the nidamental glands of some elasmobranchs of the Madras coast" and "Further observations on the nidamental glands of a few elasmobranchs" (see "Literature Cited").

¹ I should like to take this opportunity to express my sincere thanks to Mr. Nathan W. Riser for the help he rendered in collecting the material.

The material for the study includes *Hydrolagus collicii*, *Raja rhina* and *Platyrrhinoidis triseriatus*. It was collected from San Luis Obispo and Monterey Bay. The nidamental glands were fixed in Bouin's fluid and Zenker's fluid. Sections of the glands were stained with Heidenhain's iron haematoxylin, Heidenhain's Azan stain, Mallory's triple stain, and Hoyer's thionin blue.

Hydrolagus collicii (Lay and Bennett), belonging to the family Chimæridae, is oviparous. The nidamental glands are well developed and in a specimen 580 mm. in length these glands measured 39 mm. x 21 mm. (Fig. 1). In the fresh condition each gland shows externally an anterior flesh-colored region which is the albumen-secreting zone and a broad cream-colored band which is the shell-secreting region. There is a single central lumen in each of the glands which is continuous with the lumina of the cranial and caudal oviducts.

When the gland is slit open the inner surface of the first region, that externally has the flesh color, is seen to be traversed by shallow grooves. These are the cranial transverse bands. The anterior region of the second zone possesses the true lamellae, whereas the rest of the gland is characterized by the caudal transverse bands (Prasad, 1945: 285-287).

A longitudinal section of the entire gland shows anteriorly the albumen-secreting region followed by a very narrow zone of two or three rows of tubules. These are the mucus-secreting glands that resemble in position and structure those described by Nalini (1940) in *Chiloscyllium griseum*. The shell-secreting region follows next. This region displays different shades of red when treated with Mallory's triple stain. Four distinct regions could be made out. The first 19 to 20 rows of tubules stain light red, and this band is followed by a dark red region which is slightly longer than the preceding zone. A third region, the longest of all, stains just like the first band; and, lastly, there is the dark red zone of the same depth of color as the second region. A number of tubules of the last shell-secreting zone apparently function as mucus-secreting glands, since they are identical in appearance to the anterior mucus-secreting tubules. These are concentrated toward the lumen of the gland. The same phenomenon has been observed in *C. griseum* by Nalini (*op. cit.*).

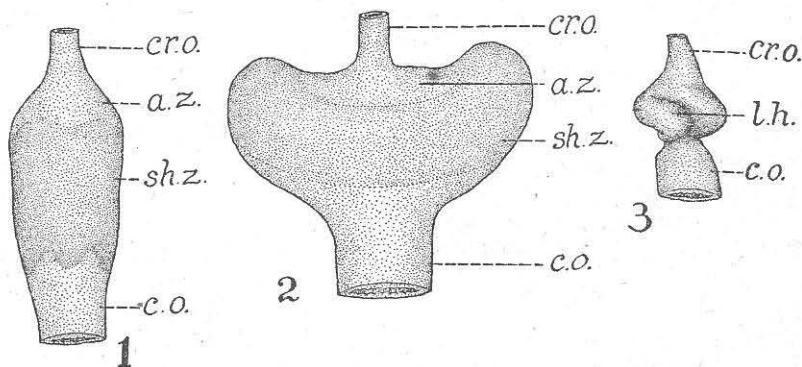
The albumen-secreting tubules, as already mentioned, open between the cranial transverse bands, whereas the shell-secreting tubules open in the region of the lamellae. The posterior mucus-secreting tubules open in the region of the caudal transverse bands. The structure and the histology of the cranial transverse bands, lamellae, caudal transverse bands and the tubules secreting albumen, mucus and the shell material have been described in other forms; and, since there are no important differences in the present species, a description of the histology is superfluous. The secretory activity of the three glandular tissues is extremely pronounced, as indicated by the granules in the cells.

The nidamental glands of *Hydrolagus collicii* thus exhibit all of the three zones: the albumen- the mucus- and the shell-secreting zones.

Raja rhina Jordan and Gilbert, the long nosed skate, belonging to the family Rajidae, is oviparous; and has the nidamental glands rather well developed, measuring 27 mm. along the longitudinal axis and 57 mm. across

in a specimen 600 mm. long (Fig. 2). When fresh, the glands externally show two distinct regions, viz., the anterior, flesh-colored, albumen-secreting zone, followed by the shell-secreting region which is distinguished by its light yellow color. There is a spacious central lumen.

The inner aspect of the gland shows, in the anterior, albumen-secreting region, the cranial transverse bands which, from a surface view, appear as shallow grooves. The anterior half of the shell-secreting zone is characterized by the lamellae, which are 35-40 in number. The remaining portion of the shell-secreting region possesses the caudal transverse bands.



Figs. 1-3. Nidamental glands of *Hydrolagus colliei*, *Raja rhina*, and *Platyrrhinoidis triseriatus*, respectively.

a. z., albumen-secreting zone; c. o., caudal oviduct; cr. o., cranial oviduct; l. h., lateral diverticulum; and sh. z., shell-secreting zone. All the figures are two-thirds natural size.

An examination of the longitudinal section of the gland reveals the first albumen-secreting zone corresponding to the flesh-colored region mentioned above. The shell-secreting region is not demarcated into different zones. Sections treated with Mallory's triple stain show only one zone of almost uniform bright red color. This is the region that has the yellow color when the gland is fresh. As in *Hydrolagus colliei*, there are tubules at the posterior end of the shell-secreting region which function as the mucus-secreting glands, but they are comparatively few in number. These tubules open between the caudal transverse bands.

There is no peculiarity in the histological make-up of the glandular tissue.

One of the specimens of *Raja rhina* had an egg-case containing an egg in the left uterus; and, as was to be expected, the nidamental glands contained spermatozoa.

Platyrrhinoidis triseriatus (Jordan and Gilbert), the thornback, belongs to the guitar fish family, Rhinobatidae, and is ovo-viviparous. The nidamental glands of this fish are much smaller than in the other two species described in this paper. In a specimen 750 mm. in length, the nidamental glands measured 17 mm. across and 13 mm. along the longitudinal axis. They were of a uniform flesh color. Each gland consists of a central portion giving off two slightly twisted diverticula, one on each side of the oviduct, which extend caudad. The central region of the gland has a lumen into which the lumina of the lateral diverticula open.

A longitudinal section of the gland shows two clearly differentiated regions, a long anterior albumen-secreting zone which occupies more than two-thirds of the entire gland, and a narrow posterior band composed of 24–26 rows of tubules which is the shell-secreting zone. A careful examination of the latter region reveals that the first few tubules, seven to eight rows, stain much darker than the rest of the shell-secreting tubules.

The albumen-secreting tubules open in the region of the cranial transverse bands, which are very similar to those of the other forms studied except that they are much taller. The shell-secreting region being narrow and composed of few rows of tubules, the lamellae of this region are also consequently few. There are eight to ten rows of lamellae bearing a close resemblance to those of other species investigated.

The structure of the nidamental glands of this species is thus similar to that of other ovoviparous forms described, the mucus-secreting glands being completely absent.

The three species reported on in this paper form an interesting series in that the nidamental glands of *Hydrolagus colliei* exhibit a structure very similar to that of a typical oviparous elasmobranch; the nidamental glands of *Platyrrhinoidis triseriatus* are typical of any other ovo-viviparous species, whereas those of *Raja rhina* are intermediate in structure. In all of the oviparous forms studied till now, the narrow band of mucus-secreting tubules between the albumen-secreting and the shell-secreting zones is characteristic, whereas in the typical gland of the ovo-viviparous species like *Rhinobatus granulatus* (Prasad, 1945) the mucus-secreting glands are entirely unrepresented. The nidamental glands of *R. rhina* show certain characters that are not observed in those of other oviparous forms. In *R. rhina* the intermediate mucus-secreting tubules are completely absent, while, at the same time, mucus-secreting tubules are present in the caudal region of the gland. Thus the nidamental glands of this species exhibit an intermediate stage between the typical gland structure of the oviparous species with the mucus-secreting tubules occurring between the albumen and the shell-secreting zones, as well as at the posterior end of the nidamental gland, and the typical ovo-viviparous forms where the mucus-secreting glands are entirely unrepresented. In this species the anterior mucus-secreting tubules have disappeared while the posterior ones are still present.

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